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WATERSHED WORK PLAN

FOR

WATERSHED PROTECTION

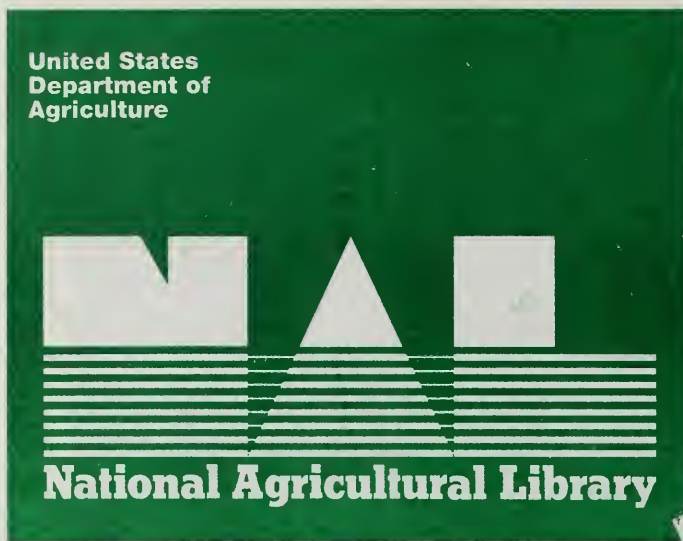
AND

FLOOD PREVENTION

ST. THOMAS - LODEMA WATERSHED

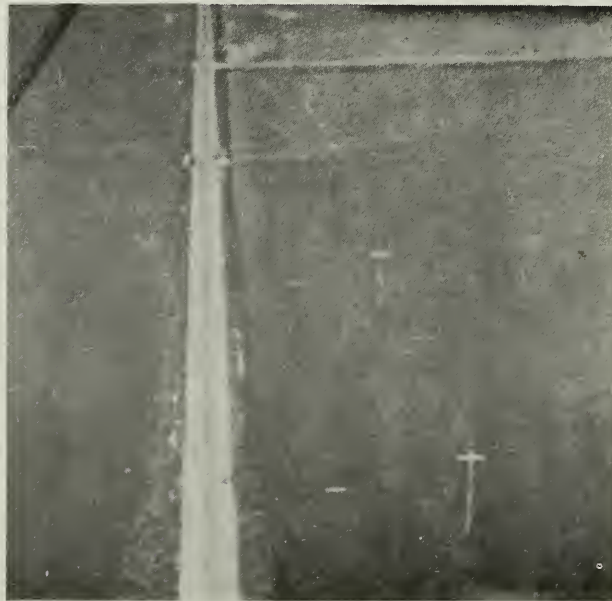
PEMBINA COUNTY, NORTH DAKOTA

NOVEMBER 1964



AERIAL VIEW A

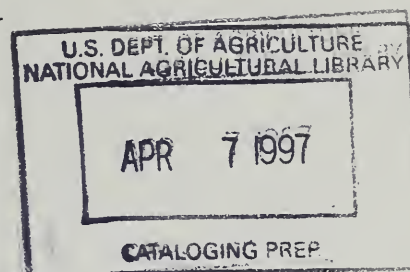
THOUSANDS OF ACRES OF VALUABLE CROPLAND FLOODED
DURING JUNE 1964 IN ST. THOMAS-LODEMA WATERSHED.



AERIAL VIEW B

COUNTY ROADS WERE THE ONLY AREAS NOT INUNDATED IN
THIS SECTION OF THE ST. THOMAS-LODEMA FLOODPLAIN
DURING JUNE 1964 .

WATERSHED WORK PLAN



ST. THOMAS-LODEMA WATERSHED

Pembina County, North Dakota

Prepared Under the Authority of the Watershed
Protection and Flood Prevention Act (Public
Law 566, 83d Congress, 68 Stat. 666) as amended.

Prepared by

West Pembina County Soil Conservation District
East Pembina County Soil Conservation District
Pembina County Water Management District
Pembina County Drainage Board

With Assistance by

U. S. Department of Agriculture, Soil Conservation Service

November 1964

TABLE OF CONTENTS

	<u>Page</u>
SUMMARY OF PLAN	1-3
DESCRIPTION OF WATERSHED	3-6
Physical Data	3
Economic Data	5
WATERSHED PROBLEMS	6-8
Floodwater Damage	6
Sediment Damage	7
Erosion Damage	8
Problems Relating to Water Management	8
Wildlife Resources	8
PROJECTS OF OTHER AGENCIES	8
BASIS FOR PROJECT FORMULATION	8-10
WORKS OF IMPROVEMENT TO BE INSTALLED	10-12
Land Treatment Measures	10
Structural Measures	11
EXPLANATION OF INSTALLATION COSTS	12-14
EFFECTS OF WORKS OF IMPROVEMENT	14-15
PROJECT BENEFITS	15-16
COMPARISON OF BENEFITS AND COSTS	16-17
PROJECT INSTALLATION	17-18
FINANCING PROJECT INSTALLATION	18-20
PROVISIONS FOR OPERATION AND MAINTENANCE	20-21
TABLES	21
Table 1 - Estimated Project Installation Cost	Following Page
Table 1A - Status of Watershed Works of Improvement	
Table 2 - Estimated Structural Cost Distribution	
Table 2A - Cost Allocation and Cost Sharing Summary	
Table 3A - Structure Data, Grade Stabilization Structures	
Table 3B - Structure Data, Channels	
Table 4 - Annual Cost	
Table 5 - Estimated Average annual Flood Damage Reduction Benefits	
Table 6 - Comparison of Benefits and Costs for Structural Measures	

TABLE OF CONTENTS (Continued)

	<u>Page</u>
INVESTIGATIONS AND ANALYSES	22-28
Hydrology and Hydraulics	22
Design	23
Geology	23
Sedimentation	23
Economics	24
Land Use and Treatment	27
	Following Page 28
PROJECT MAP	
TYPICAL CROSS SECTION, FLOODWAY AND CHANNEL IMPROVEMENT	
TYPICAL GRADE STABILIZATION STRUCTURE, CONCRETE DROP SPILLWAY	

SUMMARY OF PLAN

The St. Thomas-Lodema Watershed contains 62,848 acres located in Pembina County in northeastern North Dakota.

The project for watershed protection, flood prevention, and agricultural water management is sponsored by the West Pembina and East Pembina County Soil Conservation Districts, the Pembina County Water Management District and the Pembina County Drainage Board.

The principal water problem is flooding of agricultural land by overtopping existing channel banks and flowing across the extensive flat land areas in the watershed.

The project proposes land treatment and structural measures that, when installed, will reduce average annual damages by 72 percent.

The topography of the watershed does not provide opportunities for detention sites.

Structural measures proposed are 39.17 miles of channel improvement.

The project measures will be installed in five years.

The total project cost is \$1,190,345. The P.L. 566 share is \$662,614. The share of the cost other than from P. L. 566 funds (hereinafter referred to as "Other") is \$527,731.

Land owners and operators will install and maintain land treatment measures under agreement with their Soil Conservation District. The total estimated cost is \$331,026. P. L. 566 funds amounting to \$13,035 will be provided to accelerate the rate of

installation of land treatment measures.

The channel improvement will be installed through contracts let by the Pembina County Water Management District.

The cost of the channel improvement is \$859,319. The P.L. 566 share is \$649,579; the Other funds share is \$209,740. The Other funds include total cost of land, easements and rights-of-way of \$201,430, which includes \$1,376 for fence relocation, \$2,700 for line relocation and \$112,640 for bridges and culverts; administration of contract \$1,500; and the local funds share of the construction cost \$6,810.

The Pembina County Drainage Board will be responsible for the maintenance of the channel improvement. The estimated average annual operation and maintenance cost is \$6,864.

The average annual primary benefit attributed to the channel improvement for flood prevention and agricultural water management is estimated to be \$193,767. The average annual cost of the channel improvement is estimated to be \$41,056 resulting in a benefit to cost ratio of 4.7 to 1.

The flooding problem in this watershed was so severe in 1962, 1963 and again in 1964 that the Soil Conservation Service, at the request of the State Soil Conservation Committee, and other state and local leaders, has assisted the Sponsoring Local Organization in planning this watershed project on an emergency or "crash" basis. It could not have done so without the understanding and help of many Federal, State and local organizations. The sponsors and the Soil

Conservation Service fully appreciate their help.

DESCRIPTION OF THE WATERSHED

Physical Data

The St. Thomas-Lodema Watershed, located in Pembina County in northeastern North Dakota, contains 62,848 acres.

The principal water channel for the area is unnamed. It has its source in the beachlines at the base of the Pembina escarpment and flows eastward across the floodplain to its confluence with the Red River of the North. The channel has very low capacity throughout most of its length as it traverses the broad, level lakeplain of former glacial Lake Agassiz. The watershed is long and narrow. It is about 29 miles long and varies from 1 to 6 miles in width. Elevations range from approximately 950 feet above sea level at the headwaters to about 755 feet at the Red River of the North.

The watershed lies within the western lake section of the central lowlands province in an area of glacial drift and lacustrine plains formed by continental ice sheets during the Wisconsin Stage of ice invasion. The area is characterized by features associated with former glacial Lake Agassiz, a broad, level, lacustrine plain with an occasional beach line.

The soils in the watershed range from sandy loams to clay loams and clays.

Land use and crop distribution in the watershed follows:

<u>Land Use</u>	<u>Acres</u>	<u>Percent</u>
Cropland		
Small Grain	28,470	45.3
Row Crop	13,010	20.7
Legume	4,022	6.4
Summer Fallow	<u>13,827</u>	<u>22.0</u>
Subtotal	59,329	94.4
Non-Cropland	<u>3,519</u>	<u>5.6</u>
Total	62,848	100.0

The climate has wide seasonal variations. Records at the Cavalier weather station located four miles north of the watershed show mean monthly temperatures varying from 68 degrees in the summer to 2.3 degrees in the winter. The maximum recorded temperature is 110 degrees and the minimum is 41 degrees below zero. The average date of the last killing frost is May 27 and the earliest is September 18. The growing season averages 114 days. However, the long hours of summer sunshine in this latitude make it possible to grow and mature many different crops. The average annual precipitation is 19.05 inches. The minimum was 8.34 inches in 1952, and the maximum was 30.24 inches in 1904. The mean annual snowfall at Cavalier is 39.9 inches which is approximately 4.0 inches of precipitation. In most years snowmelt runoff causes damaging floods during March, April or May. Excess rainfall runoff causes damaging floods during May through September.

Water for domestic use is obtained from shallow aquifers in the lacustrine sediments and aquifers in the glacial till underlying the lake sediments. The quality of some of the water is poor.

Economic Data

Farming is the major enterprise in the watershed. Approximately 50 percent of the floodplain is now devoted to small grain production while potatoes and sugar beets account for about another 5 percent of the area.

A new sugar beet plant is under construction at Drayton, North Dakota, about nine miles south of the watershed. An acreage of beets has been allocated to this plant which will about double the present acreage. The only villages within the watershed proper are Bowesmont and Glasston.

Woodland is limited to field and farmstead windbreaks. All the land is privately owned. Current land values vary from \$175 to \$200 per acre. There are approximately 110 farms in the watershed. Approximately 60 percent of the farmers own all or part of their farms.

According to the 1959 Agricultural Census, land values and the size of the average farm have increased in Pembina County as shown in the following table:

<u>Year</u>	<u>Value per Acre</u> (Dollars)	<u>Size of Farm</u> (Acres)
1950	62.04	410.8
1954	79.06	437.3
1959	115.10	503.1

Population of Pembina County is 13,000 with over 50 percent of the people living in cities and villages. Cavalier, population 1,423, located about 4 miles north of the watershed, is the county seat of Pembina County. This town is the principal shopping center for the watershed.

The approximate land use in the floodplain is as follows:

<u>Crop</u>	<u>Percent of Land</u>
Wheat	21.7
Oats	9.5
Barley	9.7
Flax	5.3
Potatoes	2.7
Sugar Beets	2.4
Alfalfa	6.4
Corn (Grain)	6.9
Pinto Beans	4.2
Tame Mustard	3.6
Summer Fallow	22.0
Non-Cropland - roads, farmsteads, etc.	<u>5.6</u>
Total	100.0

WATERSHED PROBLEMS

Floodwater Damage

The maximum area flooded as determined through field interviews is 27,315 acres of which 25,785 acres is cropland. This would be the area flooded by the 1948 and 1950 snowmelt runoff events and by the September 1957 rainfall storm.

The existing channels are not big enough to carry the excess runoff. These channels are crossed by graded highways that have inadequate bridges and culverts. These restrictions and the inadequate channel capacities cause large areas to be flooded. Because of the flat terrain, floodwaters cover large areas and deposit noxious weed seeds which account for other agricultural damage. Bridges, culverts and roads are washed out requiring extra time to detour around these washouts.

Damage from snowmelt and rainfall often occurs during the same year.

Floods from snowmelt runoff cause a delay in seeding crops. Any delay beyond the normal seeding date of crops in this area of short growing seasons results in a significant reduction in yields. The micro-relief, abundance of small depressions, when wet, make it impractical to operate machinery on the irregular pattern of associated dry areas. Consequently, even minor overflow and minor area flooded has impact on larger areas of the delineated floodplain.

Floods from summer storms that exceed channel capacity cause damage to growing crops.

Some flooding occurs almost every year. Recent damaging floods have occurred in 1948, 1950, 1957, 1962, 1963 and 1964. The flooding in June, 1964, has resulted in severe crop loss on approximately 21,917 acres. The flooding situation has reached a point where farm failures may occur, if remedial actions cannot be promptly initiated.

Sediment Damage

Interviews with landowners and field spot checks indicate that major floods deposit a small amount of sediment in localized areas. The sediment is usually fertile and damages are negligible.

Wind deposited sediment in channels is a problem. Deposits restrict the free flow of water and aggravate the flood problem. This accumulation necessitates the expenditure of funds for cleanout purposes and demonstrates the need for land treatment measures to prevent sediment accumulation.

Erosion Damage

Scouring of cultivated fields occurs during the time of major flood events. The scoured areas are not large and damages are considered negligible. Fields lacking protective measures are damaged by wind erosion.

Problems Relating to Water Management

Small depressional areas are dispersed throughout the flood-plain area. These areas sustain damages from both floodwater inundation and prolonged wetness. These areas have a dual problem of flooding and drainage.

Generally, an adequate quantity of water is available for livestock from wells. This water is not always potable and some of the farms in the area haul water for domestic use.

Wildlife Resources

Due to very intensive cultivation within the watershed wildlife populations are extremely low.

PROJECTS OF OTHER AGENCIES

There are no authorized county, state, or Federal water resource projects in the St. Thomas-Lodema Watershed which would be adversely affected by the work plan.

BASIS FOR PROJECT FORMULATION

The primary purpose of this watershed project is to provide the landowners and operators with the opportunity to continue their

agricultural pursuits. This watershed, as well as other areas in Pembina County, has suffered severe flooding and water management problems. The situation has become critical. The Governor of North Dakota classified the area as a disaster area in the spring of 1964.

The flooding and associated problems have reached the point where maintaining family farms is in jeopardy. Not only are farmers in difficult financial positions, those who serve them along the main streets of the communities in Pembina County are also directly affected. Pembina County's economy is based primarily on agriculture. When agriculture is adversely affected so also is the entire community.

This watershed project is designed to strengthen the entire rural community. It will not do the entire job that is needed. Other community watershed projects are needed. Recognizing this need, the local leaders in Pembina County have submitted watershed applications for other parts of the county.

A strong rural area economy in this watershed and other areas in Pembina County is directly related to the protection, conservation and development of basic soil and water resources. The works of improvement included in this watershed work plan will help achieve the needed resource conservation.

The installation of the measures in this work plan and other proposed watershed projects in Pembina County, are needed for the development of this rural area.

Because of the topography of the watershed, floodwater retarding

structure sites do not exist. Channel improvement becomes the only feasible structural measure.

Evaluation of various channel sizes in previously developed work plans for other watersheds in the Red River Valley indicated that channel capacity based on the "M" curve most nearly meets the level of protection mutually acceptable to the sponsors and to the Service.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures for Watershed Protection

The installation of land treatment measures are essential to an effective watershed protection and flood prevention program. Land treatment measures proposed in this work plan, when installed, will exceed minimum requirements. The East Pembina and West Pembina County Soil Conservation Districts are presently engaged in this activity under going programs. The Agricultural Stabilization and Conservation Service can assist in the accelerated land treatment by providing increased ACP funds within the watershed.

Emphasis under the Watershed Protection and Flood Prevention Program is on accelerating the establishment of those land treatment measures that have a measurable effect in reducing runoff and sediment production. Particular emphasis will be given to the application of land treatment measures necessary to control wind erosion and reduce wind borne sediment deposition in the channels.

Technical assistance for the forestry measures will be furnished by the North Dakota Forest Service in cooperation with the U. S. Forest

Service under the going Cooperative Forest Management Program.

Landowners will be encouraged to preserve and improve habitat through good land use programs and to make use of the ACP Program available for wildlife practices.

Cover cropping and crop residue use measures will reduce erosion hazards, help maintain organic matter and soil tilth, and increase the water holding capacity of the soil. Field windbreaks will be planted to protect soil resources and control snow that might be deposited in the channels and in surface ditches.

On-farm surface field ditches will be installed to convey flood flows back to channels. These on-farm water disposal systems will be accelerated above the going rate so that at least 75 percent of needed disposal systems will be installed by the end of the installation period. These ditches are needed to fully realize the benefits to the structural works of improvement.

Structural Measures

A total of 39.17 miles of channel improvement will be constructed. The channel improvement will be designed with "M" curve capacity. The improvement will vary from major enlargement to minor cleanout of the existing water courses in the watershed.

The total cost of the channel improvement is \$859,319.

The structure location shown on the watershed map is approximate. Final design will dictate the beginning and termination of the channel improvement. In no event, however, will any channel improvement extend west of North Dakota State Highway No. 18.



Physical data for the channel is shown in Table 3. Cost data is shown in Table 2.

EXPLANATION OF INSTALLATION COSTS

Total project installation costs are estimated at \$1,190,345.

Estimated costs for installation of needed land treatment measures account for \$331,026. Landowners and operators will furnish \$316,130 in establishing land treatment. The Agricultural Stabilization and Conservation Service will share in this cost for approved practices.

Technical assistance costs associated with the installation of land treatment measures is estimated to be \$14,696. The Soil Conservation Service will furnish \$14,646 and \$50 will be provided by the North Dakota Forest Service through the Cooperative Forest Management Program. The current annual rate of technical assistance available to the local Soil Conservation Districts to be used within the watershed will be continued during the project installation period at a cost of \$1,661. Funds appropriated under the Watershed Protection and Flood Prevention Act will be used to accelerate the installation of land treatment measures by providing additional technical personnel to aid the Soil Conservation Districts. The cost of this additional technical assistance is estimated to be \$13,035.

Estimated cost for installation of the structural measures is \$859,319. This cost is based on planning designs. The planning designs are based on field survey data for the various stream reaches. Unit costs based on bids received in other contracts are used to estimate contract costs.



The cost of land for easements and rights-of-way is based on current market value (\$185 per acre, average).

Bridge costs computed for new bridges or needed modifications of existing structures are estimated at \$112,640.

Quantities of earth to be excavated are determined for each channel reach. Estimates are made for fill placement, spoil leveling, seeding, obstruction removal, etc. Costs for concrete and steel, needed gates, and appurtenances are included.

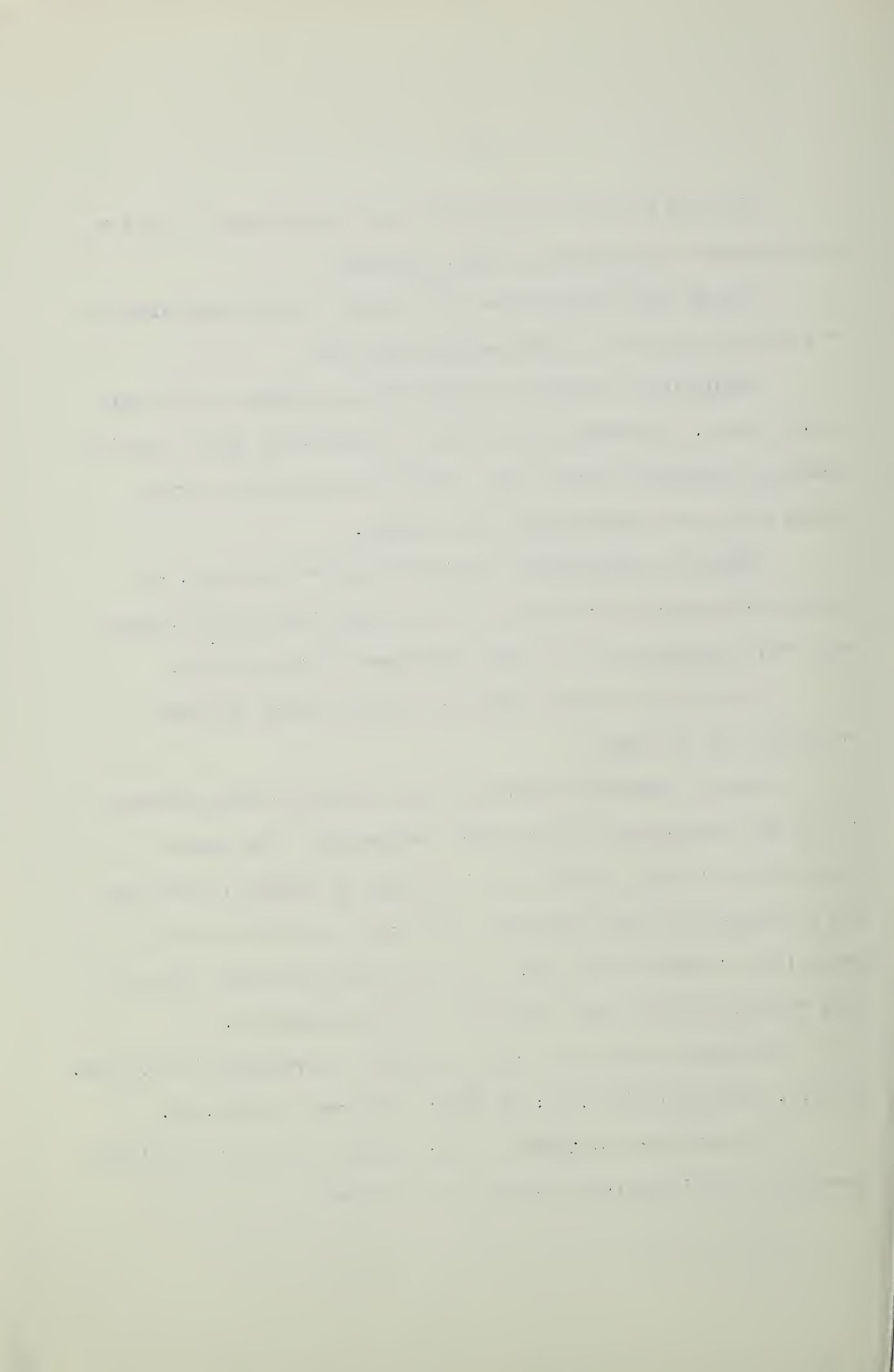
Costs for contingencies, administration of contracts, and installation services are based on actual costs for works of improvement that have been built in other watersheds in North Dakota.

The costs of channel improvement are allocated to flood prevention and drainage.

Channel improvement costs are first divided on the percentage of the dual problem area to the total problem area. The amount allocated to the dual problem area is divided 50 percent to drainage and 50 percent to flood prevention. The half allocated to flood prevention is added to the amount not allocated to the dual problem area to arrive at the total allocated to flood prevention.

The total installation cost for channel improvement is \$859,319. The P.L. 566 cost is \$649,579; the Other funds cost is \$209,740.

The estimated obligation of total project funds for each fiscal year during the installation period is as follows:



<u>Fiscal Year</u>	<u>P.L. 566</u>	<u>Other</u>
First	\$630,394	\$221,417
Second	24,399	115,519
Third	2,607	63,598
Fourth	2,607	63,598
Fifth	<u>2,607</u>	<u>63,599</u>
Total	\$662,614	\$527,731

The expected sequence of installation is as follows. The contract for all channel improvement is to be let during calendar year 1965.

Cost allocation and cost sharing determinations are explained in the Investigation and Analyses Section (page 22) of this plan and costs are tabulated in Tables 1, 2 and 2A.

EFFECTS OF WORKS OF IMPROVEMENT

The works of improvement will reduce the delay of seeding damage caused by snowmelt runoff and reduce the damage caused by flooding from summer rains. With the project completed the channel, at the watershed outlet, will contain peak flows from a 9 year frequency snowmelt storm, with protection from a less frequent rainfall storm. The 1964 rainfall storm flooded about 21,917 acres. This storm would have been nearly contained within the channel with the project installed. It is estimated that crop and pasture damages will be reduced 67 percent by the structural works. In addition, it is estimated that land treatment will reduce present damages 5 percent.

Floodwater damages will be reduced or eliminated on approximately 25,785 acres of cropland.

The areas with soils classified as w_2 and f_2 have a dual

problem of flooding and drainage. They are made up of shallow depressions of varying sizes occurring in a random pattern throughout the flood damage area. When the channel improvement is installed, the w_2 and f_2 areas will be provided with an outlet for on-farm drains, thus alleviating the drainage problem.

A new sugar beet plant is under construction at Drayton, North Dakota, about nine miles south of the watershed. An acreage of beets has been allocated to this plant which will about double the present acreage.

Potato raising has developed into a major industry. This acreage is also expected to double under flood free conditions.

Wildlife resources will not be significantly affected by the proposed project developments because present populations are extremely low.

PROJECT BENEFITS

The benefits of this project are to people; those within the watershed, in adjacent areas and along main street in the communities in Pembina County. This project will assist in stabilizing the income of the family farms affected by the flooding condition. This, in turn, bolsters the total economy of the area. Tax dollars, now being spent on road and bridge repair and replacement, will be reduced. This benefits each taxpayer.

Total monetary benefits are \$193,767 annually from the installation of the structural works of improvement for flood prevention and drainage. The largest portion, \$188,563, comes from a reduction

in floodwater damage. Annual benefits from drainage are \$5,204.

The benefits from flood prevention accrue from a reduction in crop loss. The annual benefit to crops is \$179,144.

Benefits from a reduction in other agricultural damages directly related to flood prevention are \$8,957. Most of this comes from the control of noxious weeds spread by low velocity overland flows. A minor portion of the benefits are from reductions in damage to stored grain, hay, farmsteads, and removal of debris.

Benefits to roads and bridges were not evaluated monetarily. Indirect benefits are estimated at 10 percent of the direct benefits.

In addition to the annual monetary benefits supporting the annual costs of the project, there is a reduction in floodwater damage of \$14,369 from the installation of land treatment measures.

This expression of benefits in monetary terms does not present the full extent of benefits in terms of the value of providing an adequate opportunity for family farms and rural areas to establish and maintain a strong economy.

Secondary benefits which will accrue to merchants, professional people, churches, and others, although very real, were not monetarily evaluated.

COMPARISON OF BENEFITS AND COSTS

The total estimated structure cost for flood prevention and drainage is \$859,319 (Table 2 and 2A). This cost, when amortized over a 50 year period at 3 1/8 percent interest, results in an annual equivalent cost of \$34,192. The average annual cost of

maintenance is estimated at \$6,864. The total annual cost is \$41,056 (Table 4). When the project is installed and operating, the estimated average annual primary benefits are \$193,767 (Table 6). The ratio of the annual primary benefit to the annual cost is 4.7 to 1.

PROJECT INSTALLATION

The project installation period is five years.

Farmers will apply land treatment measures in cooperation with their respective Soil Conservation Districts.

The Soil Conservation Service will provide technical assistance to the Soil Conservation Districts.

Further assistance will be provided in the installation of the land treatment phases of the program from the Agricultural Stabilization and Conservation Service, Extension Service, Farmers Home Administration and the North Dakota Forest Service.

Structural works of improvement will be installed through a contract let by the Pembina County Water Management District.

The Sponsoring Local Organization will acquire all land, easements and rights-of-way. The Pembina County Water Management District has the right of eminent domain and will use this authority if necessary.

All contracts will be administered by the Pembina County Water Management District.

The Soil Conservation Service will provide installation services, to include engineering surveys, design of the structural works, preparing plans and specifications, construction inspection

and administration.

FINANCING PROJECT INSTALLATION

Local organizations sponsoring the project are active and experienced in watershed operations and procedures.

The Soil Conservation Districts will encourage the acceleration of land treatment measures. The estimated cost of installing these measures is \$331,026. The cost to landowners and operators is estimated to be \$316,330. It is expected that they will be reimbursed for a portion of this cost through the Agricultural Conservation Program.

Table 1 shows the area of land programmed for treatment and the estimated cost of technical assistance for forestry to be furnished by the North Dakota Forest Service in cooperation with the U. S. Forest Service under the going Cooperative Forest Management Program. The technical assistance for installing forestry measures will cost \$50.

The present level of technical assistance amounting to \$1,661 will be supplemented by P.L. 566 funds so that needed land treatment measures can be planned and applied during the installation period. Accelerated technical assistance to be provided by P. L. 566 funds is \$13,035.

All structural works of improvement will be installed by the Pembina County Water Management District. Funds for which the District is obligated will be raised by taxation in accordance with the North Dakota State Law governing Water Management Districts.

Funds on hand derived from previous assessments plus future resources are expected to be adequate to meet the needs during the five year installation period. The sponsors do not anticipate using the loan provisions of the Act.

The Pembina County Water Management District will obtain all land, easements and rights-of-way needed for structural measures. The Pembina County Water Management District will let and administer the contract and provide the funds for this purpose.

They will also provide the Other funds cost share for purposes other than flood prevention.

The Pembina County Water Management District will award and administer the contract for measures included in a project agreement and is the only sponsor required to sign the project agreement which includes these measures.

Total cost of all structural measures to be paid by Other funds is estimated to be \$209,740.

Before Federal financial assistance for construction is furnished, all necessary land, easements, and rights-of-way must be secured or a written statement obtained from the responsible sponsoring organization that it is able and willing to obtain all land, easements and rights-of-way by use of legal authority and (or) funds available to it.

When legal requirements have been met, the Soil Conservation Service will make available an estimated \$537,983 of P. L. 566 funds for the construction of the structural works of improvement. These

funds will be furnished as needed and as they become available.

The Soil Conservation Service will provide an estimated \$111,596 of P.L. 566 funds for installation services as noted in Table I.

Federal assistance for carrying out the works of improvement as described in this work plan will be provided under the authority of the Watershed Protection and Flood Prevention Act (P.L. 566, 83rd Cong., 68 Stat. 666) as amended.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land treatment measures for watershed protection will be installed, operated and maintained by landowners and operators under agreement with their respective Soil Conservation Districts. Representatives of the Soil Conservation Districts will make periodic inspections of the land treatment measures to determine maintenance needs and to encourage owners and operators to perform needed maintenance.

Forestry program measures after completion of the P. L. 566 project will be maintained by landowners and operators with technical assistance provided by the North Dakota Forest Service in cooperation with the U. S. Forest Service under the going Cooperative Forest Management Program.

The Pembina County Drainage Board will be responsible for the maintenance of the structural measures for flood prevention and agricultural water management. The estimated annual cost is \$6,864.

An operation and maintenance agreement will be executed for the structural measures prior to execution of project agreements and

issuing the invitation to bid on the construction contract. This agreement will be between the Soil Conservation Service and the Pembina County Drainage Board. The Board will assume responsibility for operation and maintenance simultaneously with the acceptance of the construction from the contractor. Funds needed for maintenance will be obtained by taxation.

Inspection of the structural works of improvement will be made annually and following flood producing storms. The inspections will be made by a committee composed of representatives of the sponsoring organizations and the Soil Conservation Service. Authorized representatives will have free access to inspect the structural works of improvement.

Items of inspection will include, but not be limited to, the condition of the structures and appurtenances, the vegetative cover, the need for control of vegetation to prevent any reduction of the capacity of the channels, and the accumulation of sediment. Reports will be prepared covering the inspection stating maintenance needed. The reports, together with a record of the action taken, will be kept on file by the Pembina County Drainage Board.

Operation and maintenance may be accomplished by contract or force account.

TABLE I - ESTIMATED PROJECT INSTALLATION COST

St. Thomas-Lodema Watershed
Pembina County, North Dakota

Installation Cost Item	: Acres To : Be : Treated	: Estimated Cost (Dollars) <u>1/</u> : : P.L.566 : Other : TOTAL
<u>LAND TREATMENT</u>		
Soil Conservation Service Cropland	35,570	316,130
Technical Assistance		13,035
SCS Subtotal		317,741
Forest Service Woodland	5	200
Technical Assistance		50
FS Subtotal		250
TOTAL LAND TREATMENT		13,035
<u>STRUCTURAL MEASURES</u>		
Soil Conservation Service Stream Channel Improve- ments - Miles (39.17)		537,983
Subtotal - Construction		6,810
<u>INSTALLATION SERVICES</u>		
Soil Conservation Service Engineering Services		68,012
Other		43,584
Subtotal - Installation Services		111,596
<u>OTHER COSTS</u>		
Land, Easements & R/W		201,430
Administration of Contracts		1,500
Subtotal - Other		202,930
TOTAL STRUCTURAL MEASURES		649,579
TOTAL PROJECT		662,614

1/ Price Base - 1963

Date: November, 1964

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

St. Thomas-Lodema Watershed
Pembina County, North Dakota

Measures	: Unit	: Applied : To Date	: Total Cost Dollars <u>1/</u>
LAND TREATMENT			
Field Windbreaks	Feet	1,012,000	32,890
Drainage, Field Ditch	Feet	452,990	61,743
Cover Crop & Green Manure	Acre	9,244	29,119
Crop Residue Use	Acre	14,379	15,817
Wildlife Habitat Preservation	Acre	100	1,500
Land Forming	Acre	---	---
TOTAL			141,069

1/ Price Base - 1963

Date: November, 1964

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

St. Thomas-Lodema Watershed
Pembina County, North Dakota

(Dollars) 1/

Structure Site Number or Name	:Installation Cost - P.L.566 Funds				: Installation Cost - Other Funds				Total Installation Cost
	: Installation	: Services	: Total	: Other	: Adm.of:	: Ease-	: Total		
	:Construc-:Engin- :	: : P.L. :	: Construc-: Con-: ments : Total	: tion : & R/W :	: Other :				
Channel # 1	244,639	25,659	19,819	290,117	3,097	500	89,311 ^{2/}	92,908	383,025
Channel # 2	154,428	21,569	12,511	188,508	1,955	500	55,735 ^{3/}	58,190	246,698
Channel # 3	138,916	20,784	11,254	170,954	1,758	500	56,384 ^{4/}	58,642	229,596
GRAND TOTAL	537,983	68,012	43,584	649,579	6,810	1500	201,430	209,740	859,319

1/ Price base - 1963.

2/ Includes \$50,421 for bridges and culverts and \$1,376 for fence relocation.

3/ Includes \$31,735 for bridges and culverts.

4/ Includes \$30,484 for bridges and culverts and \$2,700 for line relocation.

Date: November, 1964

TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

St. Thomas-Lodema Watershed
Pembina County, North Dakota

(Dollars) <u>1/</u>			
	: <u>Purpose</u> :		
	: Flood :		:
Item	: Prevention :	Drainage	: Total

COST ALLOCATION

Channel Improvement	837,837	21,482	859,319
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TOTAL	837,837	21,482	859,319
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COST SHARING

P.L. 566	639,980	9,599	649,579
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Other	197,857	11,883	209,740
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TOTAL	837,837	21,482	859,319
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1/ Price base - 1963

Date: November, 1964

TABLE 3A - STRUCTURE DATA

GRADE STABILIZATION STRUCTURES

St. Thomas-Lodema Watershed
Pembina County, North Dakota

	: Drainage :		: Earth :		: Type
Site No. :	Area :	Drop :	Fill :	Concrete :	Structure
	(Sq.Miles)	(Feet)	(Cu.Yds.)	(Cu.Yds.)	
Channel # 1					
711+70	69.0	1.5	510		Corrugated Metal Pipe
751+24	69.0	3.5	510		Corrugated Metal Pipe
Channel # 2					
353+51*	27.3	2.5	490		Corrugated Metal Pipe
412+43	24.3	4.1	500		Corrugated Metal Pipe
490+91	22.0	3.2	450		Corrugated Metal Pipe
545+00*	20.0	4.9	520		Corrugated Metal Pipe
590+00	20.0	3.1	500	59	Type "C"
604+06*	18.0	4.4	510		Corrugated Metal Pipe
630+00	18.0	3.1	500		Corrugated Metal Pipe
657+00	18.0	6.3	490	44	Type "C"
Channel # 3					
823+00	27.0	2.3	450		Corrugated Metal Pipe
1043+94	21.5	5.0	550		Corrugated Metal Pipe
1140+00*	15.5	2.7	480		Corrugated Metal Pipe
1160+00*	15.5	2.7	480		Corrugated Metal Pipe
1195+00*	12.5	3.6	460		Corrugated Metal Pipe
1240+00	12.5	1.6	480		Corrugated Metal Pipe
1317+08	10.0	4.5	490		Corrugated Metal Pipe
1360+00	7.5	3.6	460		Corrugated Metal Pipe
1380+00	7.5	3.0	470		Corrugated Metal Pipe
1410+00*	6.5	3.0	470		Corrugated Metal Pipe
1436+39*	6.5	2.2	450		Corrugated Metal Pipe

* Incorporated in roads.

Date: November, 1964

TABLE 3B - STRUCTURE DATA

CHANNELS

St. Thomas-Lodema Watershed
Pembina County, North Dakota

: Station : Water-: Required: Planned: : 1/ : 1/ : 1/ : Volume : Numbering : shed : Drainage: Channel: Bottom: Side: : : Velocity: of Channel : For Reach : Area : Curve : Capacity:Capacity: Width: Slope: Depth: Grade: Channel: tion													
Designation:Station:Station: (100ft.)(sq.mi.) (cfs) (cfs) (ft.) (ft.) (pct.) (ft./sec) (cu.yd.)													
No. 1	46+00	200+00	106	M	1080	1080	44	3:1	6.4	0.04	2.67	1,194,100*	
	200+00	260+00	89	M	936	935	20	3:1	7.5	0.06	2.93		
	260+00	410+00	86	M	925	925	44	3:1	7.5	0.02	1.85		
	410+00	510+00	84	M	906	906	30	3:1	7.5	0.025	2.30		
	510+00	590+00	78	M	856	855	32	3:1	6.4	0.05	2.61		
	590+00	750+00	75	M	827	827	28	3:1	6.4	0.06	2.74		
No. 2	0+00	100+00	41.6	M	458	470	16	3:1	6.0	0.05	2.30	415,300*	
	100+00	353+51	39.0	M	437	453	12	3:1	5.4	0.10	2.98		
	353+51	490+00	27.3	M	333	333	12	3:1	5.5	0.05	2.13		
	490+00	590+00	22	M	273	272	14	3:1	5.1	0.04	1.82		
	590+00	657+00	20	M	245	243	12	3:1	5.0	0.04	1.80		
No. 3	800+00	930+00	27	M	324	335	20	3:1	5.0	0.04	1.92	329,900*	
	930+00	980+00	24.5	M	301	310	14	3:1	4.3	0.10	2.68		
	980+00	1044+00	21.5	M	267	272	12	3:1	5.0	0.05	2.01		
	1044+00	1160+00	18.5	M	235	243	8	3:1	5.0	0.06	2.11		
	1160+00	1317+00	12.5	M	169	170	10	3:1	4.2	0.05	1.79		
	1317+00	1433+00	7.5	M	108	113	10	3:1	3.3	0.06	1.71		
	1433+00	1484+00	4.5	M	70	69	12	4:1	2.55	0.10	1.22		

* Total volume of excavation for each channel.
1/ At lower end of reach

Date: November, 1964

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TABLE 4 - ANNUAL COST

St. Thomas-Lodema Watershed
Pembina County, North Dakota

(Dollars)

Evaluation Unit	: Amortization of		: Operation and	
	: Installation Cost ^{1/}		: Maintenance Cost ^{2/}	
				Total
Channel Construction	34,192		6,864	41,056

^{1/} Price base - 1963; amortized at 3 1/8 percent interest for 50 years.

^{2/} Long term projected prices.

Date: November, 1964

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

St. Thomas-Lodema Watershed
Pembina County, North Dakota

(Dollars)1/

	:Estimated Average Ann.Damage:		Damage
	: Without	: With	: Reduction
Item	: Project	: Project	: Benefit
Floodwater			
Crops	248,812	69,668	179,144
Other Agricultural	12,441	3,484	8,957
Subtotal	261,253	73,152	188,101
Indirect	26,125	7,315	18,810
TOTAL	287,378	80,467	206,911

1/ Long term projected prices.

Date: November, 1964

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

St. Thomas-Lodema Watershed
Pembina County, North Dakota

(Dollars)^{1/}

Evaluation Unit	AVERAGE ANNUAL BENEFITS				Average : Annual : Cost : Ratio
	Flood Prevention :	Agricultural Water : Management :	Drainage :	Total :	
Channel Improvement	188,563 ^{2/}	5,204 ^{3/}	193,767	41,056	4.7:1

^{1/} Costs - Price base - 1963; Benefits & O & M - Long term projected prices.

^{2/} Associated costs of \$3,979 have been deducted. In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of \$14,369 annually.

^{3/} Associated costs of \$102 have been deducted.

Date: November, 1964

INVESTIGATIONS AND ANALYSES

Hydrology and Hydraulics

Hydrologic studies for this watershed were transposed from other watersheds in this area, which have similar characteristics such as soils, land use, rainfall and topography.

Historically it has been noted that snowmelt storms produce large volumes and are of long duration. Rainfall storms are of lesser volume and of shorter duration.

From previous studies from within this general area it was found that the "M" curve gives economic level of protection for agricultural land. Presently, the watershed has reaches which contain no defined channel, therefore, flooding begins almost immediately. The new channel design is taken from the "M" curve.

With the project completed the channel, at the watershed outlet, will contain peak flows from a 9 year frequency snowmelt storm, with protection from a less frequent rainfall storm. The 1964 rainfall storm flooded about 21,917 acres. This storm would have been nearly contained within the channel with the project installed.

Based on Weather Bureau Technical Paper 40 the 24 hour rainfall events with recurrent intervals are:

	<u>10 yr.</u>	<u>25 yr.</u>	<u>50 yr.</u>	<u>100 yr.</u>
Precip. (inches)	3.3	3.8	4.4	5.0
Runoff (inches)	1.16	1.52	1.97	2.44

With average antecedent moisture conditions the soil cover complex number under present conditions ranges from 70 to 75, with the proposed land treatment applied the soil cover complex number will be about two points less over most of the area.

Design

Grades and velocities of the channel are based on cross sections and profiles obtained by field surveys.

Geology

Geologic investigations will be made prior to final design to determine stability of side slopes; problems of high water table and seepage control will be made only in channel reaches designated by the design engineer.

Sedimentation

Field investigations indicate that partial scour and sediment deposition damages have occurred in the watershed at various times. The deposited sediment is usually fertile. The greater portion of the sheet scour damage occurs during the higher frequency floods for which no level of protection can be afforded in this plan. These damages were not evaluated.

The major sediment problem is wind-blown material deposited in channels. Land treatment measures will be effective in reducing such accumulation.

Gully and stream bank erosion are not serious problems in the watershed and damages are considered negligible. Designed flow

velocities will be maintained at less than three feet per second to prevent channel erosion.

Economics

A net income type of analysis was used in the economic justification of this watershed.

Field interviews were made with farmers in the area to obtain the following: (1) extent of floodplain, (2) land use, (3) crop distribution, (4) without project yields, (5) with project yields, (6) cultural practices, and (7) an expression of other damages, such as roads, bridges, urban, erosion, sediment, etc. This data was summarized and then reviewed with local technicians, farmer leaders, and university professors to make needed adjustments.

The without project yields reflect loss of production due to delay in seeding from snowmelt runoff floods and cropland inundation from summer floods.

Composite acre values were established for the floodplain. Cost-return curves were drawn for each crop and net returns were calculated for the conditions that will exist, with and without project.

After studying maps, making field reconnaissance and interviewing landowners it was found that this watershed was comparable with nearby watersheds on which detail hydraulic and hydrologic information had been developed. By comparing the maximum floodplain in this watershed with the maximum floodplain and the present average

annual acres flooded in similar type watersheds, the percentage of average annual to total area subject to damage was determined. Based on these comparisons the present average annual acres flooded amounted to 57 percent of the maximum floodplain.

The maximum floodplain of the St. Thomas-Lodema Watershed was determined through field interviews. The maximum floodplain was planimetered and reduced to 57 percent to arrive at the average annual acres flooded. These acres were multiplied by the increase in net income per acre that is expected when the project is installed. This resulted in present crop and pasture damages. These damages were reduced 5 percent by applying land treatment measures and 67 percent for the structural measures.

Average annual damages within the watershed were calculated for conditions without a project with land treatment installed and after installation of the complete project. The difference between the damage at the time of initiation of each project increment and that expected after its installation constitutes the benefits brought about by that increment through reductions of damages.

Accrual of benefits are partly dependent on the installation of such land treatment measures as drainage, field ditch and land forming. All benefits have been discounted for five years to allow time for these measures to be installed.

Small depressional areas are dispersed throughout the floodplain area. These areas sustain damages from both floodwater inundation and prolonged wetness, thus necessitating a dual purpose flood prevention

and drainage channel for the depressional areas involved. Benefits to drainage were determined to be a percentage of the floodwater reduction benefits equal to the ratio of the costs allocated to drainage.

Soil survey maps in the floodplain area revealed that 5 percent of the soils were mapped f_2 and w_2 . Therefore, 5 percent of the installation cost of channels was allocated to the dual problem of flood prevention and drainage. Fifty percent of this cost was allocated to flood prevention and 50 percent to drainage. A breakdown of the cost allocation is shown in the table on page 28.

The associated costs for on-farm ditches amortized at 4 percent amounts to \$4,081 annually. These costs have been deducted from the average annual benefits. The local peoples' cost of construction for drainage in the project is \$6,810.

A considerable amount of road and bridge damage has occurred in the watershed. These damages were not evaluated.

Current prices were used to estimate installation costs and long term prices were used in the economic evaluation. The value of land, easements, and rights-of-way was based on current market value plus acquisition costs. Operation and maintenance costs on the structural measures were based on long term projected prices.

Other agricultural damages were estimated at 5 percent of the crop damages. These include loss of stored grain, damages to farm buildings and machinery, and extra cultural practices to control noxious weed infestation brought in by the floodwater.

Indirect damages were estimated to be 10 percent of the direct flood damages. These include loss of production time, extra travel and delays in conducting farm operations and other business.

Land Use and Treatment

A conservation program will be installed on private land based on the use of each acre of agricultural land within its capabilities and treatment in accordance with Soil Conservation Service technical standards for the area. Technical assistance provided from P.L. 566 funds will be used for the application of those measures which need to be accelerated beyond the going program rate. Measures to be installed under the land treatment program will have a significant effect in reducing runoff and sediment production or are necessary to realize the benefits.

The total amount of land treatment measures to be applied during the project period under going and accelerated programs, in addition to the measures already applied, will exceed the minimum requirements for application of land treatment measures called for under Public Law 566. Table I shows the acres that will be treated and the amounts for treatment and the technical assistance.

COST ALLOCATION AND COST SHARING

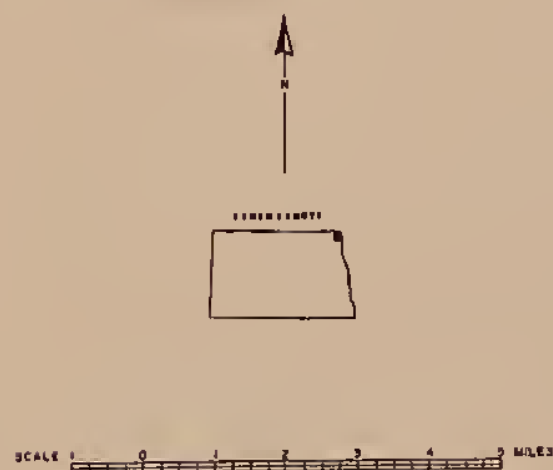
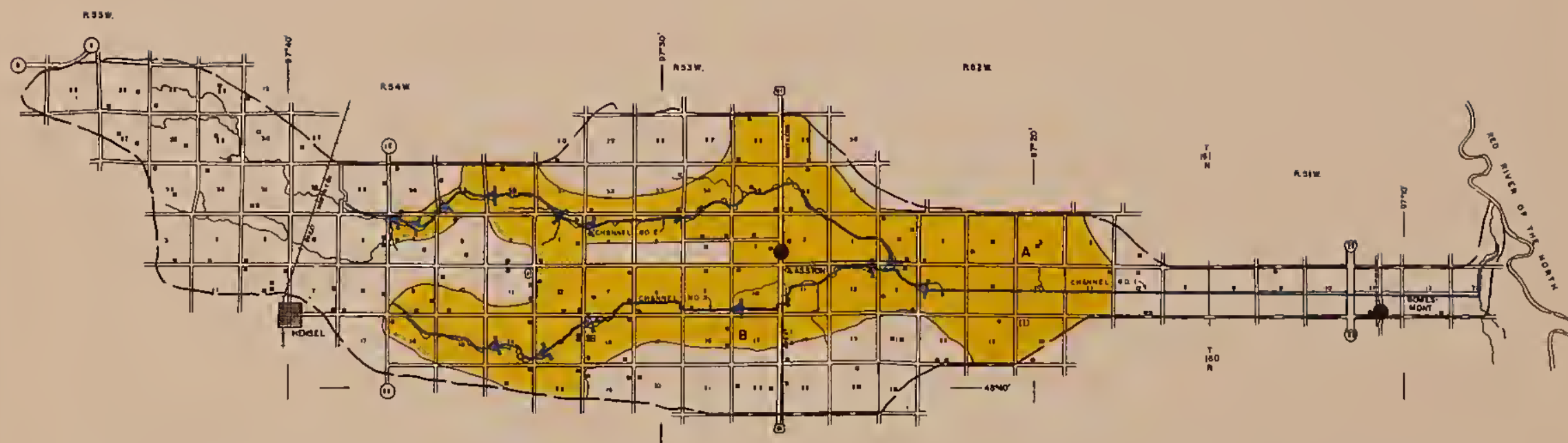
Channel Improvement

	<u>Flood Prevention</u>		<u>Agricultural Water Management</u>		<u>Total</u>	<u>Total P.L.566</u>	<u>Total Other</u>
	<u>P.L.566</u>	<u>Other</u>	<u>P.L.566</u>	<u>Other</u>			
Engineering Estimate	461,890		5,921	5,922	473,733	467,811	5,922
Contingencies	69,284		888	888	71,060	70,172	888
Total Construction	531,174		6,809	6,810	544,793	537,983	6,810
Installation Services							
Engineering Services	66,312		1,700		1,700	68,012	
Other	42,494		1,090		1,090	43,584	
Land, Easements & R/W	196,394	196,394		5,036	5,036	201,430	201,430
Adm. of Contracts	1,463	1,463		37	37	1,500	1,500
Total Installation Costs	639,980	197,857	9,599	11,883	859,319	649,579	209,740
Percent of Total		97.5		2.5	100.0		
Percent of Total Agricultural Water Management			44.7	55.3	100.0		

PROJECT MAP

ST. THOMAS-LODEMA WATERSHED

PEMBINA COUNTY NORTH DAKOTA



NOTE: THE LOCATIONS OF ALL STRUCTURAL MEASURES ARE APPROXIMATE

A LOCATION OF AERIAL VIEW (A) FRONT COVER

B LOCATION OF AERIAL VIEW (B) FRONT COVER

LEGEND

RAILROAD

ROADS

WATERSHED BOUNDARY

AREA BENEFITED

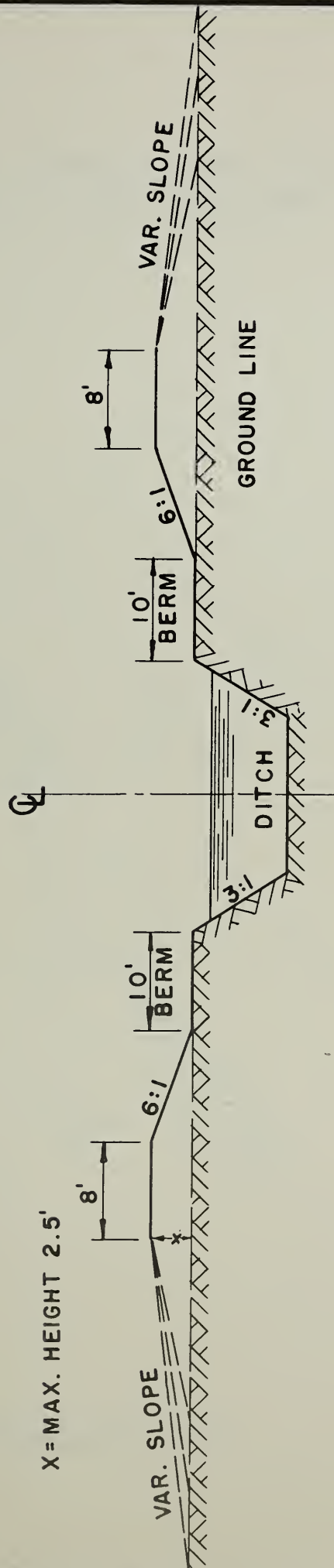
PROJECT MEASURES

CHANNEL IMPROVEMENT

DROP STRUCTURE

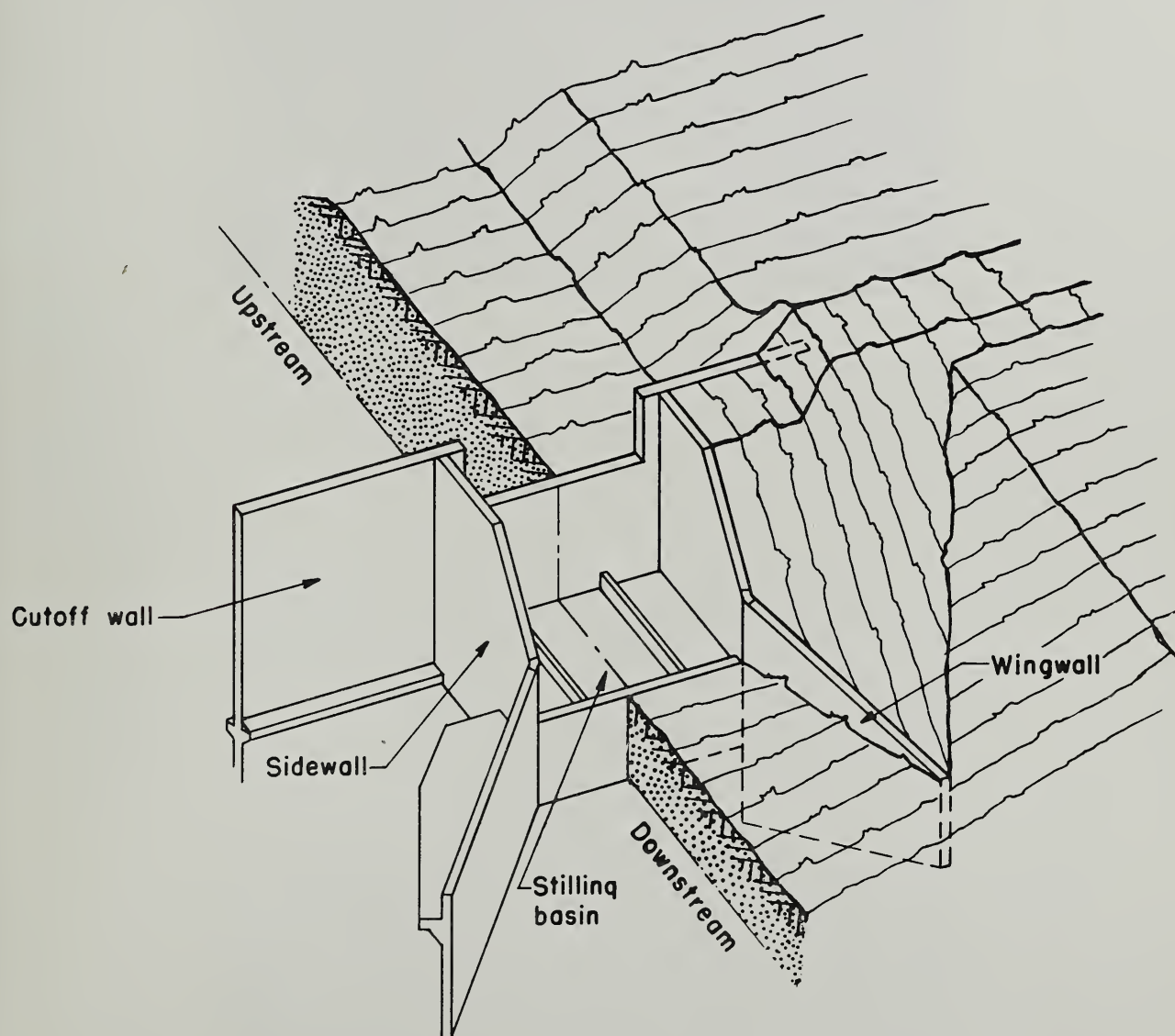


TYPICAL CROSS SECTION FLOODWAY AND CHANNEL IMPROVEMENT



U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TYPICAL GRADE STABILIZATION STRUCTURE CONCRETE DROP SPILLWAY



PERSPECTIVE VIEW



AERIAL VIEW C
FARMSTEAD SURROUNDED BY FLOODWATER CAUSING DAMAGE
AND INCONVENIENCE.



AERIAL VIEW D
JUNE 1964 FLOODING DESTROYED THE CROP ON THOUSANDS
OF ACRES IN THE ST. THOMAS-LODEMA WATERSHED.

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